



The following design method may be used for retaining walls which are 12 feet or less in height and which retain well-draining granular soil.

This does not preclude the use of designs "in accordance with accepted engineering practice" as permitted by Section 1609.2 of the Uniform Building Code. The design of retaining walls exceeding 12 feet in height must be based upon the soil characteristics and design criteria obtained by a foundation investigation performed by a registered Civil Engineer.

### I. Horizontal Force

When retaining walls 12 feet or less in height are to be designed for an assumed earth pressure, the pressure should be based upon the soil type and the slope of the backfill to be retained. The assumed earth pressure to be used for design of a wall retaining well-draining granular soil with a horizontal (level) backfill shall be not less than that listed in Table 1 for the appropriate slope. When assumed earth pressure is used for the design of a wall retaining other than well-draining granular fill, such as cohesive soils or for walls with sloping backfill, the assumed value should reflect the higher pressure exerted by the soils or slope.

The depth of the retained earth shall be the vertical distance below the ground surface measured at the wall face for a stem design or measured at the heel of the footing for overturning and sliding. A vertical component equal to one-third of the horizontal force may be assumed at the plane of application of the force.

| Table 1/Design Earth Pressure   |  |
|---|--|
| Surface Slope of Retained Material <sup>1</sup><br>(Horizontal to Vertical) | Earth Pressure<br>(Equivalent Fluid Pressure)<br>(Lb/Ft) |
| 10 to 1 (level)   | 30   |
| 5 to 1  | 32   |
| 4 to 1  | 35   |
| 3 to 1  | 38   |
| 2 to 1  | 43   |
| 1 1/2 to 1  | 55   |

<sup>1</sup> Where the surface slope of the retained earth varies, the design slope shall be obtained by connecting a line from the top of the wall to the highest point on the slope within a horizontal distance from the stem equal to the stem height of the wall.

### II. Surcharge

Any superimposed loading, except retained earth, shall be considered surcharge and provided for in the design.

- Uniformly distributed loads may be considered as equivalent added depth of retained earth. Walls retaining parking or driveway areas shall be designed for an additional one foot of retained earth.
- Where a wall is surcharged by adjacent public property, the design criteria shall be subject to the approval of the Engineering and Development Department.
- Surcharge loading due to point or line loads is illustrated in Figure 1 and shall be determined by the following formulas or an approved equivalent method:

Resultant lateral force:

$$R = \frac{0.6Ph^2}{x^2 + h^2}$$

Location of lateral resultant:

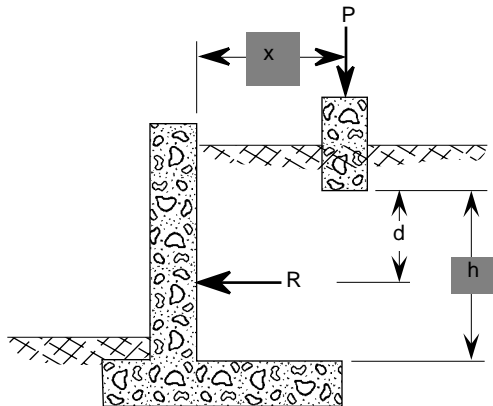
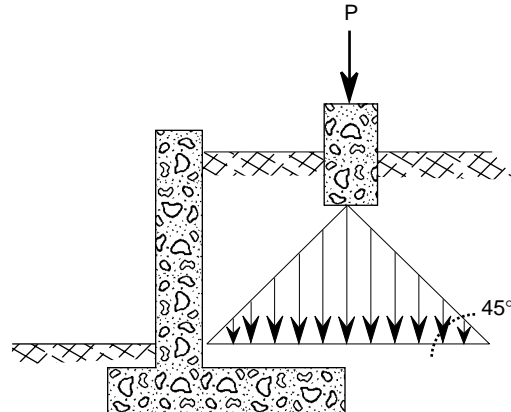
$$d = x \left[ \left( \frac{x^2}{h^2} + 1 \right) \left( \tan^{-1} \frac{h}{x} \right) - \left( \frac{x}{h} \right) \right]$$

#### Where:

- R = Resultant lateral force measured in pounds per foot of wall width. R need not exceed 0.55P.
- P = Point or line load surcharge measured in pounds per foot of length parallel to the wall
- x = Distance of point or line load from the back face of wall measured in feet
- h = Depth below point of application of surcharge loading to top of wall footing measured in feet
- d = Depth of resultant below point of application of surcharge loading measured in feet

$$\left( \tan^{-1} \frac{h}{x} \right) = \text{angle in radians whose tangent is equal to } \left( \frac{h}{x} \right)$$

- Any resultant lateral force "R" for a footing shall be assumed to be uniform for the length of footing parallel to the wall, and to diminish uniformly to zero at a distance "x" beyond the ends of the footing. For isolated footings having a width parallel to the wall less than three feet, "R" may be reduced to one sixth of the calculated value.
- Vertical pressure due to surcharge applied to the top of the wall footing may be considered to spread uniformly within the limits of the stem and planes making an angle of 45 degrees with the vertical. See Figure 2.

**Figure 1/Lateral resultant****Figure 2/Vertical Pressure****III. Bearing Pressure and Overturning**

The maximum vertical bearing pressure under any retaining wall shall not exceed that allowed by Table No. 18-I-A of the UBC, or that recommended by a special foundation investigation. Retaining walls shall be designed to resist overturning by at least 1.5 times the overturning moment.

**IV. Friction and Lateral Bearing**

Retaining walls shall be restrained against sliding by friction of the base against the earth, by lateral resistance of the soil or by a combination of the two.\*

- A. Allowable lateral bearing, lateral sliding resistance and sliding coefficient shall not exceed those listed in Table No. 18-I-A of the UBC except as provided by a special foundation investigation.
- B. Retaining walls shall be designed to resist sliding by at least 1.5 times the lateral force.
- C. When used, keys shall be assumed to lower the plane of frictional resistance and the depth of lateral bearing to the level of the bottom of the key. Lateral bearing pressures shall be assumed to act on a vertical plane located at the toe of the footing.

**V. Special Conditions**

Whenever the adequacy of the foundation material to support a wall is questionable, or whenever an unusual surcharge condition exists or the retained earth is so stratified or of such a character as to invalidate normal design assumptions, a special foundation investigation shall be made. A special foundation investigation may also be required due to site geologic hazard in accordance with City of San Diego Municipal Code Section 91.1804.8.

**\*General Conditions of Use**

1. A one-third increase in lateral bearing values will be permitted to resist loads caused by wind pressure or earthquake forces. No increases are permitted for frictional values.
2. Lateral bearing values are permitted only when concrete is deposited against a minimum of 12 inches of natural ground or properly compacted fill approved by the Development Services Department.